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ABSTRACT

The relationships between reaction time (RT), movement time (MT), visual hemi-space preferences in RT and MT, and the Peabody Picture Vocabulary Test (PPVT) were investigated in order to evaluate reaction time as a measurement practice with very young children. The sample was composed of 49 white, middle-class children ranging in age from 24 to 77 months and clustered into three age categories. A variation of the reaction time device described by Jensen (1980, 1981) was used to record RT and MT scores. All testing was conducted individually by a certified school psychologist in the child's home or in a regularly attended day care center. Results suggest that, since performance time was shown to decrease with age, both RT and MT are developmental phenomena. Significant correlations between RT, MT, and PPVT scores suggest that RT and MT may be related to general cognitive ability. Since median RT is correlated significantly with right hemi-space RT but not with left, visual hemi-space differences also provide support for the concept of psychological intelligence. (RH)

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Reaction Time as a Predictor of PPVT Performance in Preschoolers

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A critical component of intelligence as measured by psychometric tests in common use by school psychologists is the "g" or "general ability" factor (Jensen, 1979), so called because it accounts for the positive intercorrelations observed among diverse measures of cognitive ability (Reynolds, 1981). The "g" factor has been said to represent the best predictor of subsequent academic achievement, and to have the highest heritablity of all factors identified with intelligence (Jensen, 1980a).

Recent work by experts in intelligence test research, notably Arthur Jensen (1980b; 1981), has reexamined earlier investigations (e.g., Galton, 1902; Peak & Boring, 1926) associating reaction time (RT) performance with intelligence. Jensen's (1979, 1980b) research has reported that reaction time, when appropriately measured, is consistently negatively correlated with intelligence, and that this may comprise a valid estimate of "g". There is speculation that reaction time is an index of the speed of cortical processing (Head, 1926; Reynold, 1981), and support for this association comes from recent studies showing significant correlations between RT and average evoked potentials (Jensen, Schafer, & Crinella, 1981). Reaction time performance also has been demonstrated to correlate in the anticipated direction with specific measures of achievement (Carlson & Jensen, Note 1).

In addition to "g", a second factor in cognitive development, which Reynolds (1981) identifies as psychological intelligence, may have even more significant implications for school psychologists. Psychological intelligence, as defined by Reynolds (1981), refers to the mechanism by which information is processed. Individual differences in information processing strategy (e.g., successive vs. simultaneous, sequential vs. holistic, linguistic vs. visuo-spatial) have been identified by numerous investigators (Bever, 1975; Das, Kirby, & Jarman, 1975; Witkin, Dyk, Faterson, Goodenough, & Kays, 1962). Individual cognitive styles have been associated with specific neuroanatomical asymmetries of the two hemispheres of the brain (Chi, Dooling, & Gilles, 1977; Galaburda, LeMay, Kemper, & Geschwind, 1978), as well as with functional asymmetries in neuropsychological test performance (Geschwind, 1977; Witelson, 1977).

A variety of procedures have been used to identify cerebral processing strategies in children (Hartlage, 1981; Obrzut, 1981), including visual field asymmetries. Because of the contralateral organization of the visual system, it has been hypothesized that right visual hemi-field performance reflects left hemispheric processing and vice versa (Springer & Deutsch, 1981). Studies have reported that visual hemi-field performance is associated with tasks related to information processing preferences in populations of normal (Bryden, 1973) and gifted (Olson, 1978) children. Because of the specific arrangement of lights on the reaction time device, it is possible to record RT and MT performance for left and right visual hemi spaces, which may contribute to the assessment of psychological intelligence, or cerebral processing strategy.

There is little research correlating RT performance with measures of cognitive ability for preschool children. If such a relationship could be established, this would have implications for school psychologists who are concerned about early identification of at-risk, handicapped, or gifted youngsters. The RT procedure is especially attractive for use with populations of very young children, since the device itself is appealing to children, and performance does not appear to be dependent upon prior learning nor affected by practice (Jensen, 1981). Furthermore, Jensen, et al. (1981) have reported that successful reaction time measures can be obtained for profoundly retarded subjects, which suggests that the procedure may be applicable even for very young children.

Method

This investigation examined the relationship between reaction time, movement time, visual hemi-space preferences in RT and MT, and the Peabody Picture Vocabulary Test (Dunn, 1965) in order to evaluate reaction time as a measurement practice with very young children. The relationship between the PPVT and RT and MT provides some indication of the validity of RT and MT as a measure of "g" for this population. In addition, because the PPVT frequently is employed as a measure of left hemisphere processing (Hartlage, 1981; Obrzut, 1981), these

data can be examined together with visual hemi-space preferences in RT and MT for insights into psychological intelligence (Reynolds, 1981).

Subjects

The sample was composed of 49 white, middle class children (22 male, 27 female) ranging in age from 24 to 77 months. For the purpose of deriving descriptive statistics on RT and MT, the subjects were clustered into three age categories as follows: 26-34 months (n=15, mean age 30.8 months); 42-50 months (n=17, mean age 46.2 months); and 63-77 months (n=17, mean age 69.5 months).

Apparatus and Procedure

A variation of the reaction time device described by Jensen (1980b, 1981) was used to record reaction time (RT) and movement time (MT) scores. The reaction time device is comprised of a panel with semi-circular arrangment of 8 stimulus lights, which illuminate one at a time in random order. Adjacent to each light is a button which, when pressed, turns off the light. A "home" button, which the subject must depress at the start of each trial, is located in the center of the semi-circle, equidistant from each stimulus light. In the reaction time task, a warning tone is sounded, followed by the illumination of one of the 8 lights, in random order. Reaction time (RT) is the interval between the illumination of the light and the removal of the subject's finger from the "home" button. Movement time (MT) is that interval between the time the subject's finger is moved from the "home" button until the button adjacent to the illuminated light is depressed. Electronic timers on the rear of the device record these two responses (RT and MT) separately in seconds and milliseconds.

All testing was conducted individually by a certified school psychologist in the child's home or a regularly attended day care center. The RT task was introduced to the subjects by telling them it was a special game with sounds and lights. Following a demonstration trial, several orienting trials were completed. When the subject had mastered the requirements of the RT task, 15 test trials were conducted. For each trial, RT and MT, as well as the visual hemi-field presentation of the stimulus were recorded. Mean and median RT and MT were calculated for

the subjects across all trials and separately for each visual hemi-space. Descriptive statistics for RT and MT were reported for separate ages. Form A of the Peabody Picture Vocabulary Test (Dunn, 1965) was administered to all subjects following procedures outlined in the test manual, and standard scores were calculated. Pearson correlation coefficients between the PPVT and RT and MT were calculated across all subjects.

Results

Means and standard deviations of mean and median RT and MT are shown in Tables 1 and 2. Both mean and median RT and MT decreased with each successive age. All overall correlations between the PPVT and RT and MT were in the anticipated (negative) direction (Tables 3 and 4). Two of the 6 RT correlations (median RT RHS and median RT total) and 6 of the 6 MT correlations were statistically significant ($p < .05$).

Discussion

These results suggest that both RT and MT are developmental phenomena, as performance time was shown to decrease with age. The significant correlations between RT and MT and PPVT scores suggest that RT and MT may be related to "g" or general cognitve ability. Visual hemi-space differences also provide support for the concept of psychological intelligence, since median reaction time is correlated significantly with right hemi-space RT but not left.

Reference Note

1. Carlson, J. S., & Jensen, C. M. Reaction time, movement time, and intelligence: A replication and extension. Paper presented at the annual meeting of the American Educational Research Association, Los Angeles, April, 1981

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Table 1

Means and Standard Deviations

of Mean and Median RT

by Age Group

	Group 1 26-34 months	Group 2 42-50 months	Group 3 63-77 months
Median RT RHS			
Mean	.9116	.8130	.5941
SD	.3064	.1892	.1444
Median RT LHS			
Mean	1.0607	.8890	.6433
SD	.446	.2904	.2677
Median RT total			
Mean	.9669	.8398	.5826
SD	.3508	.1964	.1370
Mean RT RHS			
Mean	1.0118	1.2375	.6432
SD	.3677	1.3883	.1563
Mean RT LHS			
Mean	1.1219	1.1952	.7412
SD	.4258	.9241	.2848
Mean RT total			
Mean	1.0629	1.2337	.6863
SD	.3694	.8696	.1619

Table 2

Means and Standard Deviations

of Mean and Median MT

by Age Group

	Group 1 26-34 months	Group 2 42-50 months	Group 3 63-77 months
Median MT RHS			
Mean	1.3763	.8235	.4354
SD	.6262	.7374	.1477
Median MT LHS			
Mean	1.2533	.6912	.4119
SD	.5065	.2534	.1155
Median MT total			
Mean	1.2558	.6523	.4122
SD	.5178	.2176	.1063
Mean MT RHS			
Mean	1.6885	1.0959	.5400
SD	.5919	.8825	.4198
Mean MT LHS			
Mean	1.7388	.8389	.6360
SD	.8354	.3503	.4122
Mean MT total			
Mean	1.7359	.9656	.5990
SD	.5988	.4862	.2660

Table 3

Pearson Correlations Between PPVT and RT

for All Subjects (N=49)

Peabody Picture Vocabulary Test	r
Median RT, RVF	-.33*
Median RT, LVF	-.18
Median RT, Total	-.30*
Mean RT, RVF	-.16
Mean RT, LVF	-.13
Mean RT, Total	-.18
SD RT, RVF	-.16
SD RT, LVF	-.03
SD RT, Total	-.07

* $p < .05$

Table 4

Pearson Correlations Between PPVT and MT

for All Subjects (N=49)

Peabody Picture Vocabulary Test	r
Median MT, RVF	-.44**
Median MT, LVF	-.47***
Median MT, Total	-.46***
Mean MT, RVF	-.43**
Mean MT, LVF	-.47***
Mean MT, Total	-.49***
SD MT, RVF	-.26
SD MT, LVF	-.38**
SD MT, Total	-.37**

** $p < .01$

*** $p < .001$